

successive strata lie always in the same order, wherever pits have been dug; and sometimes the boring instrument falls in with the trunks of large trees, which the workmen pierce with great labour: They likewise meet with bones of animals, pit-coal, flints, and pieces of iron. Ramazzini, who relates these facts, thinks, that the gulf of Venice formerly extended beyond Modena, and that this land, in the progress of time, has been gradually formed by the rivers, assisted, perhaps, by inundations of the sea.

I will insist no longer upon the varieties in the composition of new strata. It is sufficient to have shown that they have been produced by no other cause than the waters which run or are stagnant upon the surface, and that they are neither so hard nor so solid as the ancient strata which were formed under the waters of the ocean.

# P R O O F S

OF THE

## THEORY OF THE EARTH.

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### ARTICLE XIX.

*Of the Changes of Land into Sea, and of Sea into Land.*

FROM what has been remarked in article 1. 7. 8. and 9. it is apparent, that the terrestrial globe has undergone some great and general changes; and it is equally certain, from what has been delivered in the other articles, that the surface of the earth has suffered particular alterations. Though we are not sufficiently acquainted with the order or succession of these particular changes, we know the principal causes by which they were produced. We can even distinguish their different effects; and, if we were able to collect all the facts which natural and civil history afford concerning the revolutions

tions that have happened on the surface of the earth, our theory would unquestionably receive additional supports, and would be rendered still more satisfactory.

One of the principal causes of these revolutions is the motion of the sea, which has continued invariably the same in all ages; for, as the sun, the moon, the earth, the waters, the air, &c. have existed from the moment of creation, the effects of the tides, of the motion of the sea from east to west, of the currents, and of the winds, must have been felt for an equal time: And, even supposing the axis of the globe to have formerly had a different inclination, and that the continents, as well as the seas, were differently disposed, the motions of the ocean, and the causes and effects of the winds, would have remained unaltered. In whatever part of the globe the immense quantities of water which fill the ocean were collected, they would be subject to the same motions.

It was no sooner suspected that our continent might formerly have been the bottom of the sea, than the fact became incontestible. The spoils of the ocean found in every place, the horizontal position of the strata, and the corresponding angles of the hills and mountains, appeared to be convincing proofs; for, when we examine the plains, the valleys, and the hills, it is apparent, that the surface of the earth has been figured by the waters. When we descend into the

the bowels of the earth, it is equally evident, that those stones which include sea-shells, have been formed by sediments deposited by the waters, since the sea-shells themselves are impregnated with the same matter that surrounds them. And, in fine, if we consider the corresponding angles of the hills and mountains, we cannot hesitate in pronouncing, that they received their configuration and direction from currents of the ocean. It is true, that, since the earth was first left uncovered with water, the original figure of its surface has been gradually changing: The mountains have diminished in height; the plains have been elevated; the angles of the hills have become more obtuse; those bodies which have been rolled along by the rivers have received a roundish figure; new beds of tufa, of soft stone, of gravel, &c. have been formed. But every thing has remained essentially the same. The ancient form is still recognisable; and I am persuaded, that every man may be convinced, by his own eyes, of the truth of all that has been advanced on this subject; and, that whoever has attended to the proofs I have given, must be fully satisfied, that the earth was formerly under the waters of the ocean, and that the surface which we now behold, received its configuration from the currents and movements of the sea.

We formerly remarked, that the principal motion of the sea is from east to west. The ocean, accordingly, seems to have gained from

the eastern coasts both of the Old and the New Continent, a space of no less than 500 leagues. For the proofs, we must refer to Art. IX. and shall here only add, that the direction of all straits which join two seas, is from east to west. The straits of Magellan, of Frobenius, of Hudson, of Ceylon, of the sea of Corea, and of Kamtschatka, lie all in this direction, and appear to have been formed by the irruption of the waters, which, being forcibly pushed from east to west, have opened these passages, where the waters still preserve a stronger current in this than in any other direction; for, in all straits of this kind, the tides are high and violent; but, in those situated on the western coasts, as that of Gibraltar, of Sunda, &c. the motion of the tides is almost imperceptible.

The inequalities at the bottom of the sea change the direction of the motion of the waters. These inequalities have originated from sediments and matters transported by the tides, or by other movements in the water: The tides are the principal and first, though not the only cause, which produced these inequalities. The wind is another cause; though its action begins at the surface, it agitates the whole mass to the greatest depths, as appears from particular bodies which are detached from the bottom of the sea, and thrown ashore during violent storms only.

It

It has already been mentioned, that, between the Tropics, and even some degrees beyond them, an east wind perpetually blows. This wind, which assists the general motion of the sea from east to west, is as ancient as the tides; because it is occasioned by the rarefaction of the air produced by the heat of the sun. There are two combined causes, therefore, the operation of which is greatest in the equatorial regions: 1<sup>st</sup>, The tides, which are greatest in the southern latitudes; and, 2<sup>d</sup>, The east winds, which constantly reign in these climates. These two causes have concurred, from the first formation of the earth, in producing a motion in the waters from east to west, and in agitating them more violently in this region of the globe than in any other. It is for this reason that we find between the Tropics the greatest inequalities upon the surface of the earth. That part of Africa which lies between these circles, is nothing but a group of different chains of mountains, which generally extend from east to west, as appears from the direction of the great rivers that traverse this unknown region. The same observation holds with regard to the countries both of Asia and America, which lie between the Tropics.

The general motion of the sea from east to west, combined with the tides, currents, and winds, produce a variety of effects, both on the bottom of the ocean, and on the coasts. Vare-

nius

nus thinks it extremely probable, that gulfs and straits have been formed by reiterated efforts of the ocean against the land; that the gulfs of Arabia, of Bengal, and of Cambaya, have been produced by irruptions of the waters, as well as the straits between Sicily and Italy, between Ceylon and India, between Greece and Eubœa, &c.; that the probability of such irruptions, and of certain lands having been deserted by the sea, is strengthened by the scarcity of islands in the middle of great seas, and by their never appearing there in groups; that, in the immense space occupied by the Pacific Ocean, there are only two or three small islands near the centre of it; and that, in the vast Atlantic Ocean between Africa and Brasil, we find only the small islands of St. Helena and Ascension: But all islands lie near large continents, as those of the Archipelago, which approach the continents both of Europe and Asia; the Canaries are near Africa; the Indian islands lie near the eastern part of the continent of Asia; the Antilles lie off the coast of America; and the Azores alone lie at a considerable distance both from Africa and America.

The popular tradition among the inhabitants of Ceylon, that their island had been separated from the peninsula of India by an irruption of the sea, is extremely probable. The great number of rocks and shoals between the island of Sumatra and the continent demonstrate their former

former union. The Malabarians affirm, that the Maldiva islands once made a part of the continent of India; and, in general, we may believe, without hesitation, that all the eastern islands have been separated from continents by irruptions of the ocean\*.

The island of Great Britain appears to have been formerly a part of the continent; and that England was once joined to France, the narrowness of the strait, and the sameness of the strata of stone and of earth on the opposite sides, are a sufficient indication. If we suppose, says Dr. Wallis, that France was connected to England by an isthmus between Calais and Dover, two tides would necessarily strike with violence against each side of it twice every twenty-four hours; and the operation of the sea, both on the east and west of this isthmus, would, in the course of time, gradually cut through such a narrow neck of land. The tides acting with violence not only against this isthmus, but also against the coasts of France and of England, must have carried away vast quantities of earth, sand, and clay, from every part on which the waves exerted their fury. Their course, however, being interrupted by the isthmus, they would not, as might be imagined, deposit their sediments upon its shores, but would transport and deposit them on the great plain which now

\* See Varen. Geogr. p. 203. 217. and 220.

forms

forms the marsh of Romney, and is four miles broad and eight long; for no man, who has ever seen this plain, can possibly doubt of its having been formerly covered with the sea, as, without the intervention of the dikes of Dimchurch, a great part of it would still be overflowed by the spring-tides.

The German sea would act in the same manner against this isthmus and against the coasts of England and Flanders, and would carry its sediments into Holland and Zeland, the soil of which was formerly under the waters, though it is now elevated 40 feet above them. On the English coast, the German sea must have occupied that large valley which commences at Sandwicl, runs by Canterbury, Chatham, Chilham, and terminates at Ashford, a space of more than 20 miles. Here the land is much more elevated than it was in ancient times; for, at Chatham, the bones of an hyppopotamos were found buried at the depth of 17 feet, and likewise anchors of ships, and sea-shells.

Nothing is more apparent than that new lands are formed by the earth, sand, clay, &c. transported and deposited by the sea: For, in the island of Okney, which is adjacent to the marshy coast of Romney, there was a flat space of ground in continual danger of being overflowed by the river Rother; but this flat, in less than 60 years, has been considerably elevated by the accretion

of

of fresh matter brought in by every tide. This river has, besides, deepened its channel so much, that its mouth, which, less than 50 years ago, was fordable by men, is now capable of receiving large vessels.

In the same manner has the bank of sand, which runs obliquely from the coast of Norfolk to that of Zeland, been formed. This bank is the place where the German and French seas encounter since the rupture of the isthmus; and it is here that the waters deposit the earth and sand which they carry off from the coasts. It is even probable that this bank of sand may, in a succession of ages, give rise to a new isthmus\*.

It is extremely probable, says Mr. Ray, that the island of Great Britain was formerly joined to France: Whether it was separated by an earthquake, by an irruption of the ocean, or by the operation of men, we know not. But the former junction of Britain to the continent is apparent from the identity of the rocks and different strata, at the same elevation, on the opposite coasts; and from the similar extent of the rocks on each side, being both about six miles. The narrowness of this strait, which exceeds not 24 English miles, and its shallowness, when compared to the depth of the neighbouring sea, render it probable that England has been separated from France by some accident. To these proofs

\* See Phil. Transf. Abridg. vol. iv. p. 227.

we might add, that wolves and bears formerly existed in this island: It is not probable that these animals could swim over, nor that such destructive creatures would be transported by men; for, in general, the noxious animals of the continent are found in all those islands which are very near it, but never in those that are remote. This fact was remarked by the Spaniards when they arrived at America\*.

In the reign of Henry I. of England, a part of Flanders was overflowed by an irruption of the sea. In 1446, more than 10,000 persons were drowned by a similar irruption in the territory of Dordrecht, and more than 100,000 round Dullart in Friseland and Zeland. In these two provinces, above 300 villages were overflowed. The tops of their towers and spires are still visible above the surface of the water.

From the coasts of France, England, Holland, and Germany, the sea has in many places retreated. Hubert Thomas, in his description of the country of Liege, assures us, that the walls of the city of Tongres were formerly surrounded by the sea, though it is now 35 leagues distant from that city. He gives several satisfactory reasons: Among others, he informs us, that, in his time, the iron rings, to which ships were fastened, still remained in the walls. The fens of Lincoln, of the island of Ely, and the Crau of Provence in France, may be regarded as

\* See Ray's *Dissertation*, p. 208.

lands

lands abandoned by the sea, which has likewise, since the year 1665, retired considerably from the mouth of the Rhone. At the mouth of the Arno in Italy, a large quantity of land has been gained from the sea; and Ravenna, which was formerly a harbour, is no longer a sea-port. The whole of Holland appears to be new land: The surface of the ground is nearly on a level with the sea, although it has received daily elevations from the mud and earths transported by the Rhine, the Maese, &c.; for the soil of Holland was formerly, in many places, computed to be 50 feet below the level of the sea.

It has been alledged, that, in the year 860, a furious tempest drove such quantities of sand upon the coast, that the mouth of the Rhine near Catt was entirely blocked up; and that this river overflowed the whole country, overturned trees and houses, and at last emptied itself into the channel of the Maese. In 1421, another inundation separated the city of Dordrecht from the main land, overwhelmed 72 villages, and drowned 100,000 persons, beside a vast number of cattle. The dike of IJssel was broken down in 1638, by the ice-boards from the Rhine blocking up the passage of the water, which occasioned an opening in the dike of several fathoms, and a great part of the province was laid under water before the breach could be repaired. The province of Zeland, in 1682, suffered a similar inundation, which drowned more than 30 villages; and an amazing



amazing number of men and cattle perished, as the unfortunate event happened during the night. The loss would have been still greater, had not a south-east wind opposed the motion of the waves; for there was such a swell in the sea, that the water rose 18 feet above the highest ground in the province\*.

The harbour of Hithe, in the county of Kent, is entirely blocked up, notwithstanding much labour and expence bestowed, on different occasions, to clear it from rubbish. For several miles round, we find an astonishing quantity of shells and other sea-bodies, which had been accumulated in ancient times, and which are now covered with soil, and afford excellent pasturage. The sea, on the other hand, often encroaches upon the land. The lands of Goodwin, for example, which formerly belonged to a Nobleman of that name, are now converted into sands, and are covered with the waters of the ocean. Thus the sea gains upon some coasts, and loses upon others, according to their different situations and circumstances†.

Upon Mount Stella, in Portugal, there is a lake, in which are found the wrecks of ships, though this mountain is 12 leagues distant from the sea‡. Sabinus, in his commentary upon Ovid's *Metamorphoses*, tells us, that, in the year

\* See les Voyag. hist. de l'Europe, tom. v. p. 70.

† See Phil. Trans. Abridg. vol. iv. p. 234.

‡ See Gordon's Geog. Gram. p. 149.

1460, a ship, with its anchors, were found in one of the Alpine mines.

These changes of sea into land, and of land into sea, are not peculiar to Europe. The other parts of the globe, if properly investigated, would furnish more striking and numerous examples.

Calecut was formerly a celebrated city, and the capital of a kingdom of that name. It is now reduced to an inconsiderable town, ill-built, and almost deserted. The sea, which, for a century past, has gained greatly upon this coast, now covers most of the ancient city. Ships moor upon its ruins, and the port is choaked up with a number of rocks, upon which many vessels have been wrecked\*.

The province of Yucatan, a peninsula in the Gulf of Mexico, was formerly a part of the sea. This neck of land stretches about 100 leagues in length, and is no where above 25 leagues broad. The air is hot and moist. The earth furnishes plenty of water, though, in so large a country, there are neither rivers nor brooks; and, when pits are dug, such multitudes of shells every where appear, as leave no room for doubting that this whole tract of land was formerly a part of the ocean.

It is a tradition among the inhabitants of Malabar, that the Maldiva islands originally belonged to the continent of India, and that they were detached from it by the violence of the ocean.

\* See Lettres Édifiantes, recueil II. p. 187.

The number of these islands is so great, and they are separated by such narrow channels, that the bow-sprits of vessels in passing, drive off leaves from the trees on each side; and, in some places, a vigorous man, by laying hold of a branch, may leap into another island\*. The cocoa trees found at the bottom of the sea, is a farther proof that the Maldivas formerly belonged to the continent.

The island of Ceylon, those of Rammanakoiel, and many other islands, it is believed, were also disjoined from the continent by currents, which, in many places of the Indian sea, are extremely rapid†. It is certain, however, that the sea has encroached 30 or 40 leagues on the north-east coast of Ceylon.

The sea appears to have lately abandoned many of the promontories and islands of America. We have already remarked, that the territory of Jucatan is full of shells. The same phenomenon takes place in the low grounds of Martinico and the other Antilles. The inhabitants distinguish the earth below the surface by the name of *lime*; because they make lime of the shells, great banks of which lie immediately under the vegetable soil‡.

There are some lands which the sea alternately covers and leaves bare, as happens in several islands

\* See *Voyages des Hollandois aux Indes Orientales*, p. 274.

† *Ibid.* vol. iv. p. 485.

‡ See *Nouv. Voyages aux Îles de l'Amérique*.

of

Norway, Scotland, the Maldiva's, the gulf of Cambaya, &c. The Baltic sea has gradually gained a great part of Pomerania; and it has covered and destroyed the celebrated port of Vinneta. In the same manner, the Norwegian sea has advanced into the continent, and formed several islands. The German sea has encroached upon Holland, near Catt, to such a degree, that the ruins of an ancient Roman citadel, which was formerly situated on the coast, lie now at a considerable distance in the sea. The marshy ground in the island of Ely, and the Crau of Province, are, on the contrary, lands which the sea has deserted. The Downs have been formed by accumulations of sand, earth, and shells successively driven upon the coasts by winds blowing from the sea. For example, on the west coasts of France, Spain, and Africa, a violent west wind reigns, by which the waters are pushed with violence against the shores; and downs, accordingly, are frequent on these coasts. The east winds, in the same manner, when they continue long, drive the waters so forcibly from the coasts of Syria and Phœnicia, that large chains of rocks, which are covered during the west winds, are left dry. Besides, downs are not composed of stones and marble, like the mountains which have been formed in the bottom of the ocean, because they have not remained long enough under the waters. That the waters of the sea possess a petrifying power, and that

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the stones formed in the earth are very different from those formed at the bottom of the ocean, is fully evinced in my discourse on minerals.

Since finishing my theory of the earth, which was composed in the year 1744, I have perused M. Barrere's dissertation on the origin of figured stones. It gave me peculiar satisfaction to find that the ideas of this accomplished naturalist, concerning the formation of downs, and the duration of the sea upon the surface of the earth which we inhabit, exactly corresponded with my own. Aiguis-mortes, which is now more than a league and a half from the sea, was a port in the time of St. Louis. Píalmodi was an island in the year 815; and it is now more than two leagues from the sea. The same change has happened at Maguelone. The greatest part of the vineyard of Agde was covered, about 40 years ago, with the waters of the sea. In Spain, the sea, within these few years, has retired considerably from Blanes, from Badalona, from the environs of the river Vobregat, from Cape Tortosa along the coast of Valencia, &c.

The sea may form hills and mountains, 1. By transporting earth, slime, sand, and shells from one place to another: 2. By depositing sediments composed of small particles detached from the bottom and from the coasts: And, *lastly*, hills and downs may be formed by sand and other particles driven against the coasts by particular winds; these are gradually deserted by the sea, and

and become parts of the dry land. The downs of Flanders and Holland are of this kind. They consist of small elevations or hills, composed of sand and shells which have been blown from the sea upon the coasts. M. Barrere gives another example, which merits observation. 'The sea,' he remarks, 'by its motion, detaches immense quantities of plants, sand, shells, and slime, from its bottom, which are continually pushed by the winds and the waves towards the coasts. The perpetual repetition of this operation must give rise to gradual accumulations of new strata, which elevate the earth, produce downs and hills, enlarge the land, and confine the sea within narrower bounds.

'It is apparent that new strata of different materials must have been formed by the constant attrition of the waters, by the deposition of sediments, and by other causes, the operation of which has been co-eval with the existence of the globe itself. Of this we have a remarkable proof in the different strata of fossil shells, and other sea bodies, found at Rouffillon near the village of Naffiac, which is 7 or 8 leagues from the sea. These beds of shells, which incline at different angles from west to east, are divided from each other by strata of earth and sand sometimes of a foot and a half, and sometimes of two or three feet in thickness. In dry weather they seem as if sprinkled over with salt, and form a chain of hillocks from 25 to

' 30 fathoms high. A long chain of hillocks of  
' such a height could not be formed at once,  
' but gradually, and by a long succession of time.  
' Effects somewhat similar might have been pro-  
' duced by an universal deluge. But, in this  
' case, the different beds of fossil shells, instead  
' of preserving a regular form, would have been  
' blended together without any order.'

I entirely agree with the sentiments of M. Barrere, except as to the formation of mountains, which cannot be ascribed solely to those causes which increase the land, and diminish the boundaries of the ocean. On the contrary, I can produce several convincing arguments to prove that most of those eminences, which appear on the surface of the earth, have actually received their original formation in the sea itself: 1. Because they have corresponding angles, which necessarily imply the cause we have assigned, namely, the motion of the currents. 2. Because downs and hills, which have originated from materials thrown upon the coasts, are not, like common hills, composed of marble and hard stones. Besides, the shells found in the former are only in the fossil state; but those in the latter are entirely petrified. Neither is the position of the strata equally horizontal in downs, as in the hills composed of marble and hard stone. They are more or less inclined, as in the hills of Nassiac. On the contrary, in the hills and mountains formed by sediments  
under

under the waters of the sea, the strata are always parallel, and often horizontal; and the shells and other matter of them are completely petrified. I despair not of being able to prove, that the marbles and other calcareous bodies, which are almost all composed of madrepores, alstroites, and shells, have acquired their density and perfection at the bottom of the ocean. But the tufas, soft stones, incrustations, stalactites, &c. which are likewise calcinable, and have been formed since the earth was left dry, can never acquire the degree of density and of petrification peculiar to marble and other hard stones.

The remarks of M. Saulmon, concerning the *galets*, which are found in many places, may be seen in the history of the French Academy, *anno* 1707. These *galets* are round, flat, finely polished pieces of flint, thrown out by the sea upon the coasts. At Bayeux, and at Prutel, which is a league from the sea, *galets* are found in digging pits and wells. The mountains of Bonneuil, of Broie, and of Quesnoy, which are 18 leagues distant from the sea, are covered with *galets*. They are also found in the valley of Clermont in Beauvois. M. Saulmon farther informs us, that a hole, 16 feet in length, was pierced horizontally into the high beach of Trespport, which consists of a soft earth; and that, in the space of 30 years, it was entirely obliterated by the sea. Supposing the sea to encroach

uniformly upon this shore, it will gain half a league in 12,000 years.

The motions of the sea, therefore, must be regarded as the principal cause of all those changes which have already happened, and of those which are daily produced upon the surface of the earth. But there are other causes, which, though less considerable, have some effect in changing the superficial parts of this globe. The rivers, the brooks, the melting of snows, the torrents, the frosts, &c. have given rise to many alterations. The rains have diminished the height of the mountains; the rivers and brooks have elevated the plains, and dammed up the sea at their mouths; the torrents and the melting of snows have scooped out deep ravines or furrows in the valleys and narrow passages between the mountains; the frosts have split rocks, and detached them from their original stations: Innumerable examples of revolutions produced by all these causes might be given. Varenus tells us, that the rivers transport into the sea vast quantities of earth, and deposit them at greater or lesser distances from the shore, in proportion to the rapidity of their currents. These portions of earth fall to the bottom, and first form small banks, which, by constant accessions, become shoals, and at last appear in the form of fertile and habitable islands. It is in this manner that the islands in the Nile, those in the river St. Lawrence, the island of Landa, situated near the mouth

mouth of the river Coanza, on the coast of Africa, the Norwegian islands, &c. have received their existence\*. To these may be added the island of Trong-ming in China, which has been gradually formed by matters brought down by the river Nankin, and deposited near its mouth. This island is more than 20 leagues in length, and from 5 to 6 in breadth†.

The Po, the Trento, and other rivers of Italy, bring down such quantities of earth into the *lagunes* of Venice, especially in the time of inundations, that they must be gradually filled up. Many parts of them are already dry during the ebb tide; and there is in them no depth of water, except in the canals, which are supported at an immense expence.

Large sand-banks are thrown up at the mouths of the Nile, of the Ganges, of the Indus, of the Plata, and of many other rivers. La Loubere, in his voyage to Siam, informs us, that the banks of sand and of earth augment daily, at the mouths of the great rivers of Asia, and to such a degree that the navigation of them becomes every hour more difficult, and will soon be impracticable. The same observation applies to the great rivers of Europe, and especially to the Wolga, which empties itself by more than 70 mouths into the Caspian, and to the Danube, which runs into the Black Sea by seven mouths, &c.

\* See Varen. Geogr. p. 214.

† See *Leures Edifiant. rec. xi. p. 234.*

As it seldom rains in Egypt, the regular inundations of the Nile proceed from the torrents which fall into it from Ethiopia. It brings down vast quantities of mud, which it deposits annually not only upon the soil of Egypt, but throws it to great distances into the sea, where it is laying the foundations of a new country, which must arise, in the course of time, out of the bosom of the ocean; for, upon founding at the distance of 20 leagues from the coast, the mud of the Nile is found at the bottom of the sea; and every year it receives fresh accumulations. The Lower Egypt, now called the *Delta*, was formerly a bay\*. Homer tells us, that the island of Pharos was a day and a night's voyage from Egypt; and now it is almost contiguous to the land. The soil of Egypt is not every where of an equal depth; it grows thinner the farther we remove from the sea. Near the banks of the Nile, there are sometimes more than 30 feet of good soil; but at the extremity of the inundation, there are not, perhaps, above 7 inches. All the cities of the Lower Egypt have been built upon artificial eminences†. The town of Damietta, which is now ten miles from the sea, was a part of the ocean in the year 1243. The town of Foosh, which, 300 years ago, was situated at the mouth of the Canopic branch of the Nile, is now 7 miles distant from it. Within

\* See Diodor. Sic. lib. iii. Aristot. de Meteor. lib. i. cap. 14. Herodot. § 4, 5, &c.

† See Shaw's Travels.

40 years, the sea has retired half a league from Rosetta, &c.\*

Many changes have also taken place at the mouths of the great rivers of America, and even in those which have been but lately discovered. Charlevoix tells us, that at the mouth of the Mississippi, below New Orleans, the land runs out into a point, which appears not to be very ancient; because, wherever the earth is dug, plenty of water is found; and besides, the many little islands which have recently appeared in all the mouths of this river, leave no room to doubt that this point of land was formed in the same manner. It is certain, says he, that when M. Salle sailed down the Mississippi to the sea, the mouth of this river was considerably different from what it is now.

The nearer, he adds, we approach the sea, this difference becomes the more conspicuous. There is no water in most of the small channels cut in the bar by the river. These channels are greatly multiplied by the trees brought down by the current. A single tree, with its branches and roots, when stopped in a shallow part of the river, will entangle a thousand. I have seen, says he, 200 leagues from New Orleans, different collections of trees, any one of which would fill all the wood-yards in Paris. Nothing can disentangle them. The mud brought down by the river serves as a cement, and gradually

\* See Shaw's Travels.

covers them. Every inundation leaves a new stratum; and, in a few years, plants and shrubs begin to grow. It is in this manner that most points of land and islands, which so often change the course of rivers, are originally produced.

All the revolutions, however, produced by rivers, are very slow, and become not considerable till after a long course of years. But those which are occasioned by inundations or earthquakes are sudden, and almost instantaneous. According to the Timæus of Plato, we are assured by the ancient priests of Egypt, 600 years before the birth of Christ, that there existed an island beyond the Pillars of Hercules, called *Atlantis*, which was larger than both Asia and Lybia taken together; and that this great island was sunk under the waters of the ocean by a terrible earthquake. 'Traditur Atheniensis civitas restitisse olim innumeris hostium copiis quæ, ex Atlantico mari profectæ, propè cunctam Europam Asiamque obsederunt; tunc enim fretum illud navigabile, habens in ore et quasi vestibulo ejus insulam quam Herculis Columnas cognominant: Ferturque insula illa Lybiâ simul et Asiâ Major fuisse, per quam ad alias proximas insulas patebat aditus, atque ex insulis ad omnem continentem è conspectu jacentem vero mari vicinam; sed intrâ os ipsum portus angusto sinu traditur, pelagus illud verum mare, terra quoque ille verè erat continens, &c. Post hæc ingenti terræ motu jugique

gigue dici unius et noctis illuvione factum est, ut terra dehiscens omnes illos bellicosos absorberet, et Atlantis insula sub vasto gurgite mergeretur.' *Plato in Timæo*. This ancient tradition is not devoid of probability. The lands swallowed up by the waters were, perhaps, those which united Ireland to the Azores, and the Azores to the continent of America; for, in Ireland, there are the same fossils, the same shells, and the same sea-bodies, as appear in America, and some of them are found in no other part of Europe.

Two evidences are mentioned by Eusebius on the subject of deluges: The one is Melo, who affirms, that all the plains of Syria were formerly laid under water: The other is Abidenus, who says, that in the reign of King Sisithrus, there was a great deluge, which had been predicted by Saturn. Plutarch *De Solertia Animalium*, Ovid, and other mythologists, describe the deluge of Deucalion, which happened, they say, in Thessaly, about 700 years after the universal deluge. It is also alleged, that there was a still more ancient deluge in Attica, during the time of Ogiges, about 230 years before that of Deucalion. In the year 1095, a deluge in Syria drowned a prodigious number of people\*. In 1164, a deluge in Friesland covered the whole environs of the coasts, and drowned several thousands of the inhabitants†. Another inun-

\* See Alsted. Chron. chap. 25.

† See Frank, lib. v. c. 4. dation,



dation, in 1218, destroyed 100,000 men. Of inundations there are many other examples.

Impetuous winds may be regarded as a third cause of changes on the surface of the globe. They not only give rise to downs and hills along the sea-coasts, but they often arrest rivers, make them regorge, and change their directions. They carry off cultivated lands, tear up trees, overturn houses, and cover whole countries with sand. Upon the coast of Brittany, in France, we have an example of these inundations of sand: The history of the Academy, ann. 1722, describes it in the following terms:

‘ In the environs of St. Paul de Leon, in Lower Brittany, there is a province on the sea-coast, which, before the year 1666, was inhabited; but now is totally deserted, on account of the sand, which has covered it to the depth of 20 feet, and which daily gains ground. Reckoning from the above period, the sand has advanced about 6 leagues into the country; and it is now within half a league of St. Paul, and that town must probably soon be deserted. The tops of steeples, and of some chimneys, still appear above this ocean of sand. The inhabitants, however, have always had leisure to quit their possessions in safety. p. 7.

‘ This calamity is augmented by an east, or a north wind, which elevate this fine sand, and carry it in such quantities, and with such rapidity, that M. Deslandes, to whom the Academy

‘ demy are indebted for the observation, when walking in this country during an east wind, found himself obliged to shake his hat and his garments from time to time, on account of the great weight of sand with which they were loaded. Besides, when the wind is violent, it carries the sand over a small arm of the sea as far as Roscof, a port much frequented by foreign vessels; and the sand accumulates in the streets of this village to the height of two feet, which obliges the inhabitants to drive it off in waggons. It may be further remarked, that the sand is mixed with ferruginous particles, which are recognisable by the magnet.

‘ The coast which furnishes this sand extends from St. Paul to Plouefcat, a space of more than four leagues; and it is nearly on a level with the sea when the tide is full. It is situated in such a manner that the east and north-east winds only can blow the sand in upon the country. It is easy to conceive how sand carried and accumulated into any place by the wind, may again be taken up by the same wind, and carried still farther. Thus the sand may continue advancing, and covering new lands, as long as the magazine from which it originally proceeds shall remain unexhausted; for, if the fountain were once dried up, the sand, by advancing, would diminish in depth, and its destructive consequences would gradually



'ally decay. But it is not improbable that the  
'sea may long continue to supply fresh sand,  
'and keep this baneful magazine in a condition  
'to do perpetual mischief.

'This disaster is not of an old date. Perhaps  
'it was not till lately that the place was sufficiently  
'stored to allow great quantities of sand  
'to be carried off; or, perhaps, it has but recently  
'been left uncovered by the waters.  
'This coast has undergone some change. At  
'present, the sea, at full tide, reaches half a  
'league on this side of certain rocks, which it  
'formerly never passed.

'This miserable province justifies what has  
'been related, both by ancient and by modern  
'travellers, that whole cities, and even vast  
'armies, have been buried by tempests of sand  
'in the deserts of Arabia.'

Mr. Shaw relates, that the ports of Laodicea, Tortosa, Rowadfa, Tripoly, Tyre, Acra, and Jaffa, are blocked up with sand transported by the high waves which rise on that part of the coast of the Mediterranean, when the west winds blow with violence\*.

It is needless to give more examples of alterations on the surface of this globe. The fire, the air, and the waters, produce continual changes, which, in a succession of ages, become considerable. The sea and the land not only

\* See Shaw's Travels.

change

change places from the effects of general and stated periodic laws, but a number of revolutions are occasioned by particular and accidental causes, as earthquakes, inundations, sinkings of mountains, &c. Thus the surface of the earth, which we regard as the most permanent of all things, is subjected, like the rest of nature, to perpetual vicissitudes.